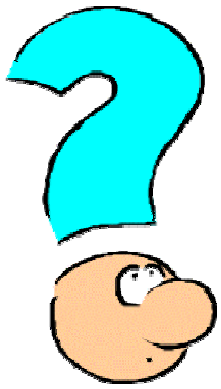
"Know Floe's Korner"



Characterizing Bulk Materials

Lyn Bates, Ajax Equipment (UK)
Shrikant Dhodapkar, The Dow Chemical Company
George Klinzing, University of Pittsburgh

1. Characterizing for flow cannot be reduced to a single numerical value as the flow potential has a multi-attribute identity. Understand and measure the upper bounds of ***'worst'*** values of the various physical properties that are likely to be encountered in the application under consideration.
2. Measure the bulk density in the extreme bulk conditions of the application, i.e. most dilated as stored, but not settled, and as most compacted in storage. A high ratio of these two values indicates there is some potential form of flow problem and the nearer the value is to one can highlight a possible tendency to segregate.
3. Measure the wall friction for possible materials of construction to establish the optimum, contact surface for slip and basis for design of hoppers, chutes and any equipment requiring relative movement between the bulk material and its containing boundary. Do not assume wall friction characteristics based on data from reference handbooks. A survey of large datasets (Figure 1) indicates that the probability of achieving mass flow at 60 degree cone angle is only between 15 to 25%.
4. Measure the shear strength at maximum compacting stress that is to be experienced in the relevant equipment and a comparative measure at 25% of this loading.
5. Evaluate the hazardous characteristics of raw materials, intermediates and products from a plant safety perspective.
6. Identify the health and exposure issues individually, based on chemical and physical properties that may be injurious or dangerous.
7. Deal with quality issues as a separate, user defined subject, with physical examples of what is just within and outside the limits of acceptability.
8. Shake a sample of the product in a half full measuring cylinder and graph the rate of settlement to produce a measure of porosity, as this will reflect how easy the material will be able to expand for flow without undue resistance of a negative pressure in the expanding, interstitial voids.
9. A 'representative' sample for equipment design purposes is then the one that has the most unfavorable qualities relevant to the form of equipment under consideration.
10. Add other relevant values that may influence the design or above values, e.g. particle size, for potential blocking of flow channel, moisture content that may vary due to ambient or process conditions. Note that presence of moisture attains a maximum bulk strength beyond which increase in moisture reduces the bulk strength.